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Letter to the Editor

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Is Arterial Stiffness Related to Body Height?

To the Editor:

Experts[1] consider aortic pulse wave velocity (PWV) as the supreme index of arterial stiffness, mainly because it is an independent predictor of cardiovascular complications.[2] However, the noninvasive assessment of PWV is critically dependent on the measurement of the travel distance of the arterial pulse wave.[3] Variability between estimates of PWV largely depends on inconsistencies in the measured travel distance.[4] Travel distance is proportional to body height.[5] This explains the inverse association between PWV and body height. In a recent publication in *Hypertension*, Wang et al[6] recognized the problem and adjusted the hazard ratios expressing the risk of death related to a pulse wave reflection index for body height.

The Colin VP-1000 (Omron Healthcare) is easy to operate and is used for risk stratification, in particular in Japan and China.[7] This device measures brachial-ankle PWV (baPWV) by means of an automated wave form analyzer. In 200 subjects (51.5% women; mean age: 51.3 years; age range: 20 to 80 years) recruited in the framework of the Flemish Study on Environment Genes and Health Outcomes,[8] we observed a strong inverse association between baPWV and body height (Table). However, the VP-1000 device computes baPWV automatically as $(L1-L2)/T$.[9] L1 is the distance from the heart to the ankle, L2 is the distance from the heart to the arm, and T is the time delay between the feet of the brachial and tibial arterial waveforms. The VP-1000 computes L1 and L2 from the height (H) of the subjects as $L1=0.2195\times H-2.0734$ and $L2=0.5643\times H-18.381$.[9] For this reason, we believe that the inverse association between baPWV and body height is spurious. Leading experts in the field recently proposed other formulas to extrapolate travel distance from height.[5] Another limitation of baPWV is that this index mixes the characteristics of the elastic aorta and subclavian arteries and the muscular brachial, femoral, and tibial arteries.

In the same Flemish Study on Environment Genes and Health Outcomes participants,[8] we also measured aortic PWV from the length of the carotid-femoral segment and the transit time of the pulse wave. The carotid-femoral segment (cfD) was the distance between the suprasternal notch and the site of the femoral measurement (nfD) minus the distance between the site of the carotid measurement and the suprasternal notch (cnD). We measured these distances using a measuring tape. Thus, for aortic PWV, travel distance was not extrapolated from height. In contrast to baPWV, aortic PWV was not significantly correlated with body height (Table). Nevertheless, cfD ($r=0.41$), nfD ($r=0.56$), and cnD ($r=0.43$)) were all closely correlated ($P<0.0001$) with body height, highlighting that even the best index of arterial stiffness not only depends on the characteristics the measured arterial segment.

We also measured the central and peripheral systolic augmentation indices.[8] We used a high-fidelity SPC-301 micromanometer (Millar Instruments, Inc) interfaced with a laptop computer running the SphygmoCor software, version 7.1 (AtCor Medical Pty Ltd). Measurement of the systolic augmentation indices does not involve travel distance. Nevertheless, in line with our previous study of a Chinese population,[10] we noticed a significant inverse association between systolic augmentation and body height (Table), which can be easily explained by the faster return of the reflected wave in shorter people.

Table. Association of Various Indices of Arterial Stiffness With Body Height

Characteristic	All Subjects	Women	Men
No. of subjects	200	103	97
Brachial-ankle PWV, cm/s per cm	−5.39±2.00*	−16.21±4.51†	−14.88±2.82†
Carotid-femoral PWV, cm/s per cm	1.10±1.32	−2.70±2.36	−2.10±2.51
Central AI, %/cm	−1.26±0.18†	−1.48±0.36†	−1.24±0.37*
Peripheral AI, %/cm	−1.01±0.15†	−1.31±0.29†	−1.05±0.30†

AI indicates systolic augmentation index. Values are single regression coefficients±SE.

*$P<0.01$ indicates significance of the regression coefficient.

†$P<0.0001$ indicates significance of the regression coefficient.

In conclusion, travel distance remains a major problem in the standardization and interpretation of PWV as the favored[1] index of arterial stiffness. The inverse association between PWV and height is overestimated if travel distance is extrapolated from height. For the same height, aortic PWV reflects only arterial stiffness, but if height is dissimilar PWV reflects both arterial properties and the difference in stature. We suggest that PWV be expressed standardized to height (and heart rate) and that analyses involving PWV as the explanatory variable should be adjusted for body height (and heart rate), as done recently by Wang et al.[6]

Disclosures

None.

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